Thermal Diffusion and Soret Feedback in Suspensions of Gold-Doped Nanospheres

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In toluene dispersed microgel nanospheres of poly(trimethoxymethylsilan) of 50 nm diameter, after being doped with gold clusters, absorb within the visible spectrum. Absorption of laser light leads to a nonuniform temperature distribution and, due to the Ludwig-Soret effect, to a spatial modulation of the concentration. With the holographic grating technique of thermal diffusion forced Rayleigh scattering we have been able to measure the Soret-, thermal and mass diffusion coefficients of gold doped and plain nanospheres and of aggregates of the latter in dilute solution. Within the experimental error, we found identical thermal diffusion coefficients.

Since the optical absorption is directly coupled to the species undergoing thermal diffusion, there is a coupling between the heat release within the sample and the migration of the nanospheres out of the illuminated regions in case of positive Soret coefficients. While this nonlinear feedback is negligible for the holographic grating experiment with modulation amplitudes far below 1 mK, it can be substantial in the case of thermal lensing experiments and significantly modify the self-modulation behavior of a partially absorbed transmitted laser beam. We will present a simple model, how Soret photobleaching can clearly be distinguished from photochemical bleaching.